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AFFIDAVIT OF ACCURACY

I, Michelle Ganswindt, hereby certify that the following is, to the best of my knowledge and belief, a true and accurate translation of the accompanying document [Q79410] from German into English.

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Sworn to before me this
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My Commission Expires 01-01-2008

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District of Columbia

Description

Method and device for displaying information pertaining to a system part of an industrial system on a mobile display

This invention relates to a method and a device for displaying information pertaining to a system part of an industrial system on a mobile display.

In conjunction with industrial production and manufacturing systems, where the system parts may be set up at locations that are far apart, it is already known that mobile display devices may be used. These display devices have a display on which information regarding the particular system part can be displayed in the form of images and alphanumeric data. This displayed information may contain a detailed view of the system part, alphanumeric information such as process data, instructions to the operator and alarm information and curves pertaining to the system part.

To access this information, the user must manually retrieve data belonging to the particular system part from an associated central analysis station. To do so, the user must have knowledge of the structure of the entire industrial system, which may also include a plurality of central analysis stations. On the basis of this knowledge, the user must navigate in the database stored in the analysis station to arrive at the data belonging to the desired system part. This is tedious and time consuming. In addition, it is a disadvantage here that the operator requires knowledge about the layout of the industrial system, in particular information about the design phase and a displayed system guide.

Such a scenario is described in WO 02/075466 A2, for example. The subject of the discussion there is operation and/or observation of equipment monitoring a system control. This has a control unit coupled with the system on at least one separate operating device that communicates with the monitoring equipment. An additional function block is provided, in particular in the form of an additional program, as part of the monitoring equipment or a device connected to it. The additional function block intervenes in communication between the monitoring unit or a monitoring function block on the one hand and the connected operating devices on the other hand in the manner of an interface module, analyzing the information directed to a connected operating device and processing this information so that the information which is then relayed can be displayed directly by the respective operating device in the manner of a terminal. The connection between a central operating and monitoring device and/or a server and the decentralized operating device and/or client computer can be made by data lines that run together in a star pattern at the server, via a network having a ring structure, whereby each connected client computer has an individual address, via infrared or wireless interfaces, via a national data network or via an internal data network, where the communication may also, if necessary, be carried across the oceans by satellite.

The object of this invention is to avoid the disadvantages of known systems described above.

This object is achieved by a method having the features characterized in Claim 1 and a device having the features characterized in Claim 7. Advantageous embodiments and further developments of this invention are derived from the dependent claims.

The advantages of this invention consist, in particular, of the fact that an operator automatically receives information which belongs to the system part in or at which the operator is situated at the moment as a video signal on the display of the mobile display device. This increases the convenience in operational, service and diagnostic work in complex industrial systems. In particular, the condition of a system part can be diagnosed quickly and accurately on site. This diagnosis can also be performed by less qualified personnel because in contrast with the state of the art, no tedious step-by-step retrieval of data from a central unit is necessary. Instead, this invention permits direct insight from a mobile unit on site into the information belonging to the respective system part, which is then displayed automatically as a result of transmission of an identifying signal which identifies the system part. If the identifying signals are transmitted in the form of radio signals, then the automatic display of the information belonging to the system part is initiated as soon as the user comes into the vicinity of the system part with a mobile display device.

According to one embodiment of this invention, the radio transmitter of the system part emits the radio signal identifying the system part as a continuous pulsating signal.

According to another embodiment of this invention, the radio transmitter of the system part emits the radio signal identifying the system part only when there is a malfunction in the system part. This avoids in an advantageous manner an unnecessarily large number of radio signals being emitted at the same time within one system.

An advantageous further development of this invention consists of providing a first operating mode in which the radio transmitter of the system part emits a continuous pulsating radio signal which identifies the system part, providing a second operating mode in which the radio transmitter of the system part emits the radio signal identifying the system part only when there is a malfunction in the system part, and providing an option for switching between the two aforementioned operating modes.

If there is overlapping in time due to transmission of radio signals of multiple system parts, then different priorities are automatically assigned to the received signals in an advantageous manner according to Claim 4. This assignment is advantageously configurable by the operator. For example, the operator has an opportunity to add additional information to the radio signal identifying the system part, said additional information concerning, for example, signaling an emergency, signaling an error or signaling a malfunction-free state and assigning a higher priority to an emergency than to a simple error message, which in turn is assigned a higher priority than the malfunction-free state. If radio signals of different priorities arrive at the mobile display device at the same time, then the radio signal having the highest priority or a transmission signal derived therefrom is automatically relayed first to the central analysis station, which then automatically sends the information concerning the system part transmitting the radio

signal having the highest priority back to the display device, so that it can be shown on the display. A transmission of radio signals having a lower priority is postponed temporarily.

According to the features of Claim 5, the operator is given an opportunity to perform a priority assignment on site on the basis of a selection video signal shown on the display.

The advantages of a device having the features characterized in Claim 6 consist in that when there is a plurality of analysis stations, the operator need not concern himself about which of these stations he must retrieve the particular desired information from. This is recognized automatically by analysis of the radio signal transmitted at the time.

Additional advantageous properties of this invention are derived from the explanation of exemplary embodiments on the basis of the figures, in which:

FIG 1 shows a block diagram of a device according to a first exemplary embodiment of this invention,

FIG 2 shows a block diagram of a device according to a second exemplary embodiment of this invention and

FIG 3 shows a block diagram of a device according to a third exemplary embodiment of this invention.

FIG 1 shows a block diagram of a device according to a first exemplary embodiment of this invention. The device shown here has a central analysis station 8 in which all the essential data belonging to an industrial system A is stored. This essential data includes images of system parts prepared as part of the design phase and process data belonging to the system parts, whereby this process data is sent to the central analysis station in the course of the process. The essential data also includes a location identifier which individually identifies the particular system part and describes the location of that system part. System parts include, for example, boilers, regulators and valves. An example of a location identifier is as follows:

"Boiler 22-Beer powder-Bldg 22-sector 7-room 18-square C9."

The central analysis station 8 is connected to a mobile display device 1 by a transmission link 7. The transmission link 7 is a wireless transmission link by which signals can be transmitted over great distances. The mobile display device is a small hand-held device that can be carried in the hand of an operator and can be operated in that way. For example, display device 1 may be a so-called personal digital assistant (PDA), a cell phone or a mobile industrial communicator. Mobile industrial communicators are offered on the market by the present patent applicant under the

trademark MOBIC® and are usually used in mobile applications for acquiring quality data, for inspection of spare parts lists, for visualizing process states, for acknowledging work orders or for receiving detailed use plans.

The mobile display device 1 shown in FIG 1 has a display 2, an operating keyboard 3, a radio receiver 4, a controller 5 and a sending and receiving unit 6. The latter is provided for output of signals to the transmission link 7 and for reception of signals transmitted by the central analysis station 8 over the transmission link 7 to the mobile display device 1. The radio receiver 4 is used to receive signals transmitted by the radio transmitter of a radio module which is set up in or on a system part of an industrial system A.

The industrial system A shown here has system parts A_1, ..., A_n. A radio transmitter S_1 is provided for a system part A_1, a radio transmitter S_2 is provided for a system part A_2, a radio transmitter S_3 is provided for a system part A_3 and a radio transmitter S_n is provided for a system part A_n. Each of these radio transmitters is a component of a radio module. The radio transmitter S_1 emits radio signals s1. The radio transmitter S_2 emits radio signals s2. The radio transmitter S_3 emits radio signals s3 and the radio transmitter S_n emits radio signals sn. In each case, the range of the radio signals emitted by these radio transmitters is short, so the radio receiver 4 of the mobile display device 1 is able to receive the signals emitted by said radio transmitter only when the mobile display device 1 is brought into the vicinity of the respective system part.

If an operator would like to conduct on-site operation, maintenance or inspection of one of the system parts, then this person would proceed with the display device 1 to the immediate vicinity of this system part. FIG 1 shows the display device 1 positioned in the immediate vicinity of the system part A_2. In this position, the radio receiver 4 of the display device is capable of receiving the radio signals s2 emitted by the radio transmitter S_2. These radio signals s2 identify the system part A_2. They contain a location identifier, which describes the location of the system part A_2.

The radio signal received by the radio receiver 4 or a transmission signal derived therefrom is forwarded by the sending and receiving unit 6 to the transmission link 7 and is relayed via said transmission link to the central analysis station 8. On the basis of the transmitted signal, this recognizes that the display device is currently situated in proximity to the system part A_2 and is transmitting information concerning the system part A_2 back to the display device 1 via the transmission link 7. This transmitted information includes, for example, a graphic view of the system part created as part of the design phase of the industrial system, alphanumeric data belonging to that system part and current process data belonging to that system part, said data being available in the central analysis station 8. This information sent back via the transmission link 7 is received by the sending and receiving unit 6 of the display device 1 and is then either displayed directly on the display 2 of the display device 1 or is displayed after signal processing, if necessary.

All the processes described above take place automatically as soon as the radio signal s2 identifying the system part A_2 is received by the radio receiver 4 of the display device 1. Consequently, there is no need for an operator to

perform a step-by-step retrieval of the information concerning the system part A_2 by performing manipulations on the keyboard 3 of the display device 1 or navigating in a database stored in the central analysis unit 8. In comparison with the solutions known previously, this constitutes a great simplification for the respective user. In particular, the user need not have any detailed knowledge of the overall layout of the industrial system nor does he need any detailed knowledge of the design phase of the system. Furthermore it saves time because in the procedure according to this invention, the desired information is displayed much more quickly on the display 2 than is the case in the state of the art.

According to a first embodiment of this invention, the radio transmitters $S_1...S_n$ continuously emit their radio signals as pulsating signals. This has the advantage that the radio signals can be received at any point in time. All that is necessary is for the display device 1 to be brought into the vicinity of the particular system part.

According to a second embodiment of this invention, the radio transmitters $S_1...S_n$ emit their radio signals only when there is a malfunction in the particular system part. For example, the central analysis station 8 is notified of a malfunction by a sensor in a system part. Because of this malfunction message, a service technician equipped with a display device 1 is sent to the system part where the malfunction has occurred. As soon as the service technician is within the reception area of the radio signals identifying the system part with the malfunction, these signals are received by the radio receiver 4 of the display device 1. As a result of this, the respective information belonging to the system part with the malfunction is automatically shown on the display 2 of the display device 1. This information includes a graphical representation of that part of the system and alphanumeric and/or visual instructions for the required procedure to eliminate the trouble.

The advantage of the second embodiment according to which the radio signals are emitted only when there is a malfunction in a system part is, in particular, the fact that an unnecessarily great number of radio signals is not emitted within the industrial system.

FIG 2 shows a block diagram of a device according to a second exemplary embodiment of this invention.

The device shown in FIG 2 differs from the device shown in FIG 1 in that, in addition to analysis station 8, it has additional analysis stations 9 and 10, as is advantageous in large industrial systems for reasons of capacity. The analysis stations 8, 9 and 10 are interconnected, as indicated by the dotted line in FIG 2. Consequently, there may be an exchange of data between the analysis stations if necessary.

All the essential data belonging to the system part A_1 of the industrial system is stored in analysis station 8. This essential data includes a graphical view of the system part A_1 created as part of the design phase and process data belonging to the system part A_1, whereby this process data is sent to the analysis station 8 in the course of the process. The essential data also includes a location identifier, which individually identifies the system part A_1 and describes the location of the system part A_1.

All the essential data belonging to the system part A_2 of the industrial system is stored in analysis station 9. This essential data includes a graphical view of the system part A_2 prepared as part of the design phase and process data belonging to the system part A_2, whereby this process data is sent to the analysis station 9 in the course of the process. The essential data also includes a location identifier, which identifies the system part A_2 individually and describes the location of the system A_2.

All the essential data belonging to the system parts $A_3...A_n$ is stored in the analysis station 10. This essential data includes graphic views of the system parts $A_3...A_n$ prepared as part of the design phase and process data belonging to the system parts, whereby this process data is sent to the analysis station 10 in the course of the process. The essential data also includes the location identifiers which individually identify each of the system parts $A_3...A_n$ and describe the location of the system part.

The analysis stations 8, 9 and 10 are each connected to a mobile display device 1 via a transmission link 7. The transmission link 7 is a wireless transmission link via which signals can be transmitted over great distances. As in the exemplary embodiment according to FIG 1, the mobile display device 1 is a small hand-held device, which can be carried and operated in an operator's hand. It has a display 2, an operating keyboard 3, a radio receiver 4, a controller 5 and a sending and receiving unit 6. The latter is connected to one of the transmission links 7 for output of signals and is provided for reception of signals sent by one of the analysis stations 8, 9, 10 via one of the transmission links 7 to the mobile display device 1. The radio receiver 4 is used for receiving signals emitted by the radio transmitter of a radio module which is located in or on a system part of an industrial system A.

The layout of the industrial system A according to FIG 2 corresponds to the layout of the industrial system A according to FIG 1.

One difference between the device shown in FIG 2 and the device shown in FIG 1 is that the controller 5 has the function of an analysis unit that determines, on the basis of the particular radio signal received, in which of the analysis stations 8, 9 or 10 the information belonging to the system part emitting the radio signal is available. Information regarding this is contained, for example, in the radio signal emitted by the particular system part. If the analysis unit 5 has determined the particular analysis station responsible, then it relays the received radio signal or a transmission signal derived therefrom to the analysis unit thus determined via the particular transmission link 7. The analysis unit then identifies, on the basis of the transmitted signal, the system part emitting the radio signal and

sends the information belonging to the system part back to the display device 1 via the transmission link 7 so that this information can be shown on the display 2 of the display device 1.

An alternative to the embodiment described above consists in that the display device 1 relays the received radio signal or a signal derived from it to the next analysis station. In a case in which the desired information is available in one of the other analysis stations, this analysis retrieves the desired information from the other particular analysis station and then transmits it back to the mobile display device 1 on the display of which it is shown.

Consequently, according to this exemplary embodiment, the required information is automatically retrieved from the particular respective analysis station. The operator does not require any information regarding which analysis station has the information available that belongs to a certain system part.

FIG 3 shows a block diagram of a device according to a third exemplary embodiment of this invention. The device shown in FIG 3 differs from the device shown in FIG 1 in that the system parts A_1, A_2 and A_3 are arranged close together. As a result, the radio receiver 4 of the mobile display device 1 can receive radio signals emitted by the radio transmitters S_1, S_2 and S_3 simultaneously.

To eliminate the problems associated with this, the controller 5 of the display device 1 has a collision recognition component which, in the case of reception of a plurality of different radio signals, automatically assigns different priorities to the received radio signals.

A first possibility for priority assignment consists of assigning different priorities to the individual system parts as such. In the case of a collision, the highest priority is assigned to the radio signals emitted by the system part having the highest priority. These radio signals or signals derived from them are first relayed to the central analysis unit 8, which then sends the respective information to the mobile display device 1 for display on the display 2. Transmission of the signals having a lower priority is initially postponed and then is caught up at a later point in time.

Another possibility for priority assignment is to transmit another identifier in the radio signal transmitted, such that the additional identifier provides information about the operating mode of the particular system part. For example, the identifier contains information regarding whether an emergency has occurred in the system part, whether a minor error has occurred in the system part that should be eliminated when the occasion arises or whether the system part is in a malfunction-free state. The highest priority is assigned to an emergency, a medium priority is assigned to an operating state involving an error and a low priority is assigned to the malfunction-free state.

For example, if a radio signal indicating an emergency is emitted by the system part A_3, a radio signal indicating an error is emitted by the system part A_2 and a radio signal indicating a malfunction-free state is emitted by the system

part A_1, then the collision recognition component 5 will ensure that the radio signal displaying the emergency or a transmission signal derived therefrom will be the first to be relayed to the central analysis station 8. The latter first makes available information belonging to the system part A_3, this information being transmitted back via the transmission link 7 to the display device 1 and shown on its display 2. The information displayed contains a graphical representation of the system part A_3 as well as alphanumeric instructions for eliminating the emergency. Transmission of signals having a lower priority is postponed at first and is caught up at a later point in time.

According to an advantageous further development of this invention, the priority assignment described above can be configured by the user by means of the operating elements 3 of the mobile display device 1. For example, the user may modify, if necessary, a priority assignment made originally. If during operation of the industrial system, it is found that all the operating states of a certain system part which deviate from malfunction-free operation of this system part are to be observed with priority, then this circumstance may be taken into account by a modified priority assignment.

Another embodiment of this invention consists of equipping the display device 1 with a collision recognition component 5, which in the event of reception of a plurality of different radio signals, provides a selection video signal, which is shown on the display 2. In this display, the operator can select one of the system parts from which the colliding radio signals originate by using the operating elements 3 of the display device. If the operator has made this selection, then first the radio signal of the selected system part or a transmission signal derived from this radio signal is relayed to the central analysis unit 8, which then transmits the respective information back to the mobile display device 1 shown on the display 2. Transmission of the signals of the system parts not selected is postponed for the time being and is caught up again at a later point in time.

In the exemplary embodiments described above, the information identifying the particular system part was transmitted as a radio signal to the display device 1. This radio transmission is preferred because of the lower complexity and because of the high reception certainty. However, it is also possible to transmit the information identifying the particular system part to the display device 1 by some other method, e.g., as an infrared signal or by using a cable. In the case of an infrared transmission, however, the reception certainty is reduced in comparison to a radio transmission. In the case of cable transmission, the display device and the particular system part must be interconnected by a cable.

List of Reference Notation

A	industrial system
A_1, ..., A_n	system parts
M_1, ..., M_n	radio modules
S_1, ..., S_n	radio transmitters
S1, ..., sn	radio signals
T_1, ..., T_n	operating elements
1	mobile display device
2	display
3	operating elements
4	radio receivers
5	controllers
6	sending and receiving unit
7	transmission link
8	analysis station
9	analysis station
10	analysis station

WHAT IS CLAIMED IS:

1. Method of displaying a video signal on the display of a mobile display device, whereby
- a signal (s1,...,s6) which identifies the system part is transmitted by a transmitter of a system part (A_1,...,A_n) of an industrial system (A),
- the transmitted signal is received by a receiver (4) of the display device (1),
- the received signal or a transmission signal derived from it is automatically relayed by the display device (1) to an analysis station (8),
- the analysis station (8) automatically transmits information belonging to the system part to the display device (1), and
- a video signal corresponding to the information is automatically shown on the display (2) of the display device (1).

2. Method as claimed in Claim 1, characterized in that the signal identifying the system part is a radio signal, and the radio signal is emitted as a continuous pulsating signal.

3. Method as claimed in Claim 1, characterized in that the signal identifying the system part is a radio signal and the radio signal is transmitted only when there is a malfunction in the system part.

4. Method as claimed in any one of the preceding claims, characterized in that in the case of reception of a plurality of different signals transmitted by transmitters in different system parts, different priorities are automatically assigned to the received signals.

5. Method as claimed in any one of Claims 1 through 3, characterized in that in the case of reception of a plurality of different signals transmitted by transmitters of different system parts, a selection video signal is automatically shown on the display of the display device and on the basis of this selection video signal the operator is able to select one of the system parts from which the signals originate, and the signal assigned to the select system part or a transmission signal derived from that is first relayed to the central analysis station.

6. Method as claimed in any one of the preceding claims, characterized in that an analysis station belonging to the system part transmitting the signal is determined in the mobile display device on the basis of the received signal, and the signal or a transmission signal derived from it is relayed to the analysis station thus determined.

7. Device for displaying a video signal on the display of a mobile display device, comprising
- a transmitter (S_1,...,S_n) which is situated at a system part (A_1,...,A_n) of an industrial system (A) and is provided for transmitting a signal (s1,...,s6) which identifies the system part,
- a display device (1) which has a display (2), a receiver (4) and a sending and receiving unit (6) whereby the receiver (4) is provided for receiving the signals (s1,...,sn) transmitted by the transmitter (S_1,...,S_6) of the system part (A_1,...,A_n), and the sending and receiving unit (6) is provided for automatically relaying the received signal or

a transmission signal derived from it to an analysis station (8),

- the analysis station (8) is provided for reception of the signal transmitted by the display device (1) and for automatic transmission of the information pertaining to the system part to the display device (1), whereby
- the sending and receiving unit (6) of the display device (1) is provided for receiving the information transmitted by the analysis station and the display (2) is provided for displaying a video signal corresponding to this information.

8. Device as claimed in Claim 7, characterized in that the signal identifying the system part is a radio signal and contains a location identifier that contains information regarding the location of the system part in the industrial system.

9. Device as claimed in Claim 7 or 8 characterized in that the transmitter is emitting the signal continuously as a pulsating signal.

10. Device as claimed in Claim 7 or 8, characterized in that the transmitter emits the signal only when a malfunction is present.

11. Device as claimed in Claim 10, characterized in that the transmitter (S_1,...S_n) is part of a module (M_1,...,M_n) and the module has an operating element (T_1,...,T_n) by means of which the transmitter can be switched to different operating modes, whereby a first of the operating modes is a continuous pulsating transmission of the signal and a second of the operating modes is a transmission of the signal only in the case when a malfunction is present.

12. Device as claimed in any one of Claims 7 through 11, characterized in that the display device (1) has a collision recognition component (5) which in the case of reception of a plurality of different signals, automatically assigns a different priority to each of the received signals.

13. Device as claimed in Claim 12, characterized in that the mobile display device (1) has operating elements (3) by means of which the priority assignment can be configured.

14. Device as claimed in any one of Claims 7 through 12, characterized in that

- the display device has a collision recognition component (5) which in the case of reception of a plurality of different signals provides a selection video signal which is shown on the display (2),
- the display device has operating elements (3) by means of which one of the system parts from which the signals originate can be selected on the basis of the selection video signal, and
- the sending and receiving unit (6) of the display device (1) is provided to relay the signal assigned to the selected system part or a transmission signal derived from it first to the analysis station (8).

15. Device as claimed in any one of Claims 7 through 14, characterized in that the mobile display device (1) has an

analysis unit (5) which, on the basis of the received signal, determines an analysis station (8, 9, 10) belonging to the system part transmitting the signal, and the sending and receiving unit (6) of the mobile display device (1) is provided to relay the signal or a transmission signal derived therefrom to the analysis station thus determined.

ABSTRACT OF THE DISCLOSURE:

Method and device for displaying information pertaining to a system part of an industrial system on a mobile display

This invention relates to a method and a device for displaying information pertaining to a system part of an industrial system on a mobile display.

Each system part of the industrial system has a transmitter which transmits a signal that identifies the system part. This signal is received by a receiver of the mobile display device and is relayed to a central analysis station. This makes available information belonging to the system part and transmits it back to the display device. There video signals corresponding to the information sent back are shown on the display. Preferably all the aforementioned processes take place automatically as soon as the display device is brought into the vicinity of the system part.

FIG 1

FIG 1

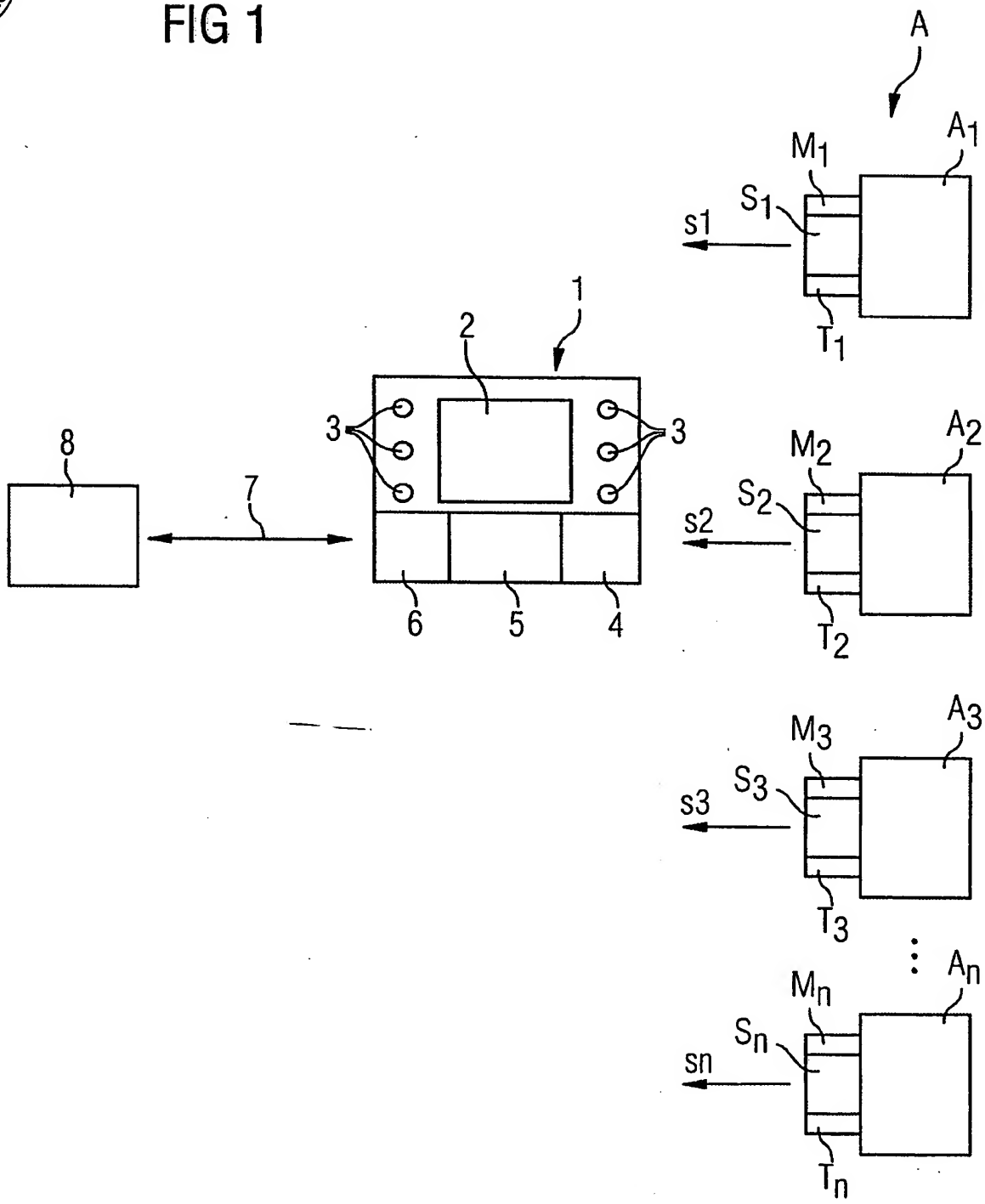
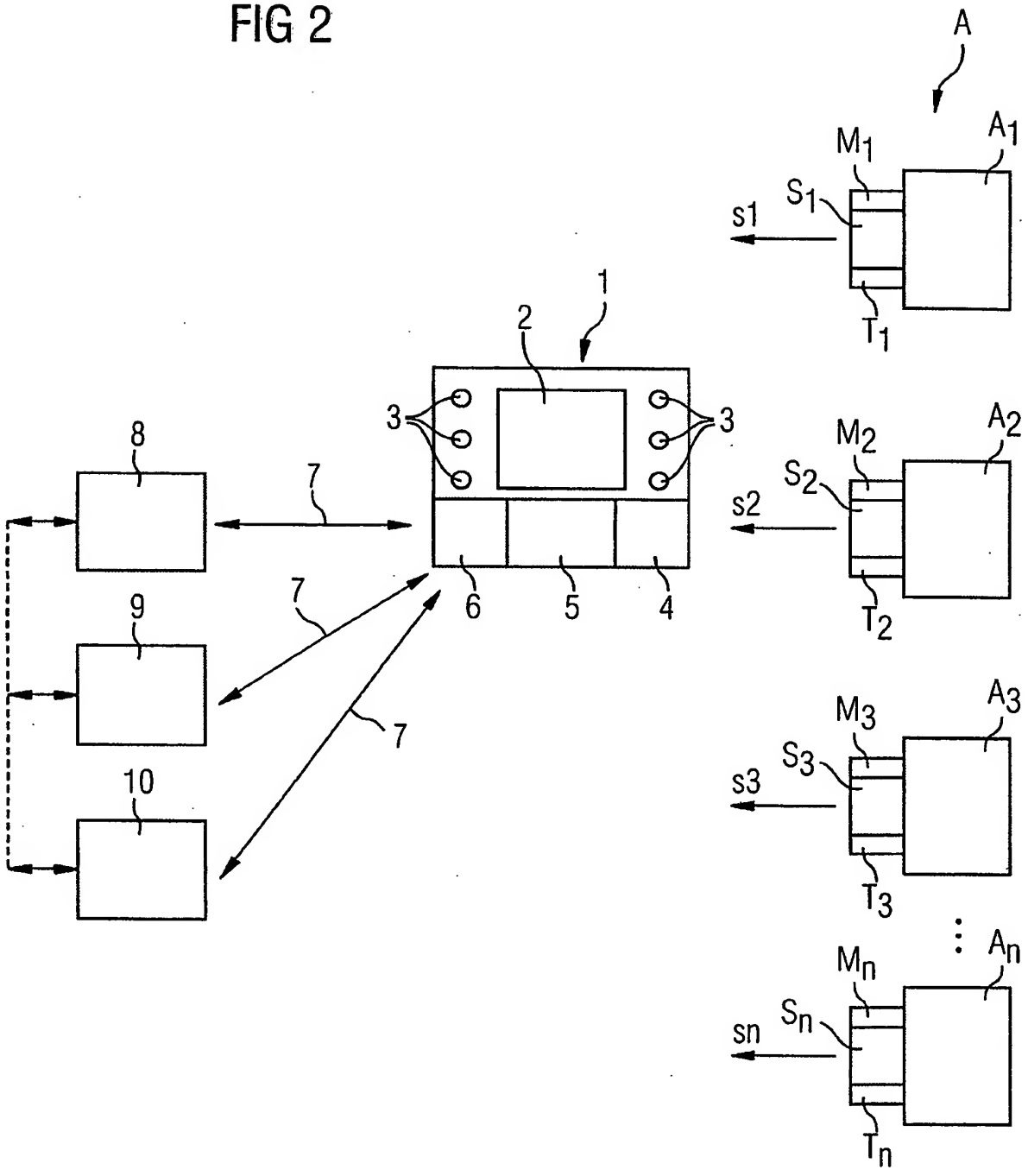


FIG 2


A
A1
M1
S1
s1
T1
1
2
3
3
A2
M2
S2
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8
7
9
7
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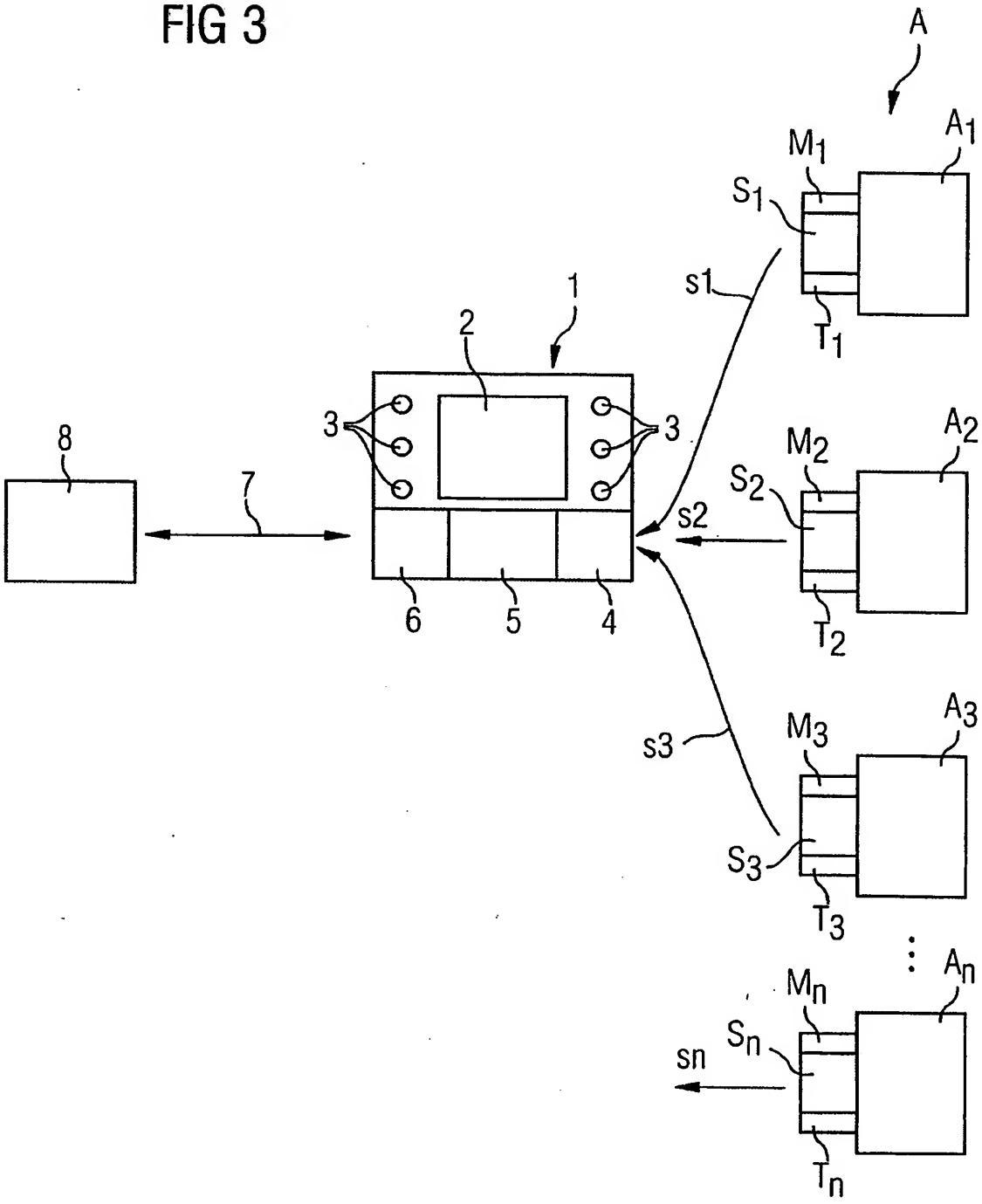
FIG 3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A3
S3
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An
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Sn
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